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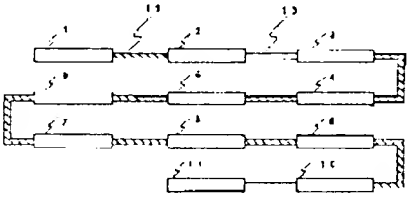
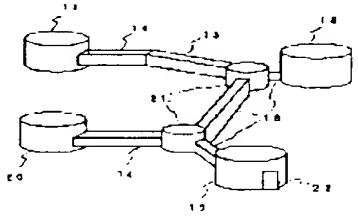
(54) MANUFACTURE OF THIN FILM DEVICE

(57)Abstract:

PURPOSE: To avoid the oxidation of a substrate which is caused by the atmosphere by a method wherein, after the substrate is put into film forming and processing facilities from the atmosphere, the substrate is not taken out into the atmosphere.

CONSTITUTION: A substrate is transferred by a conveyance line 12 whose atmosphere is substituted by inert gas. An Al film is formed on the substrate by a sputtering apparatus 2 and the substrate is transferred by a conveyance line 13 which is in a depressurized state. After an SiN film, an a Si film and an n-type a-Si film are formed by a glow discharge method in a CVD apparatus 3, the substrate is transferred in inert gas again and resist is applied by a coating apparatus 4. Thus, without being exposed to the atmosphere, the substrate is transferred through an aligner 5, a development apparatus 6 and an etching apparatus 7 and the resist is removed by a resist peeling apparatus 8. Then the side surfaces of the Al wiring are inactivated by an anode formation apparatus 9 to complete a gate line and an a-Si pattern. After a sputtering process in an ITO sputtering apparatus 10, the substrate is transferred to a laser processing apparatus 11 without breaking a vacuum. A drain pattern is drawn by a laser beam with a wavelength suitable for removing ITO to complete a TFT





DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the manufacture method of a transistor, and relates to the manufacture method of the liquid crystal display of the active matrix method which used the thin film transistor etc. especially.

[0002]

[Description of the Prior Art] The liquid crystal display of an active matrix method prepares a nonlinear element (switching element) corresponding to each of two or more pixel electrodes arranged on the matrix. There is a thin film transistor (TFT) as a thing typical as a switching element, and the liquid crystal display of the active matrix method which used the thin film transistor is known for the Nikkei tuna UHIRU issue on JP,63-309921,A, "the 12.5 type active matrix method electrochromatic display display which adopted the redundant configuration" and the Nikkei electronics, a page 193 - December 15, 1986 [210 or]. The process forms a thin film on a glass substrate, and consists of recurrence of the routine which processes this. Moreover, although the difference between a glass substrate and a silicon wafer has a substrate also about a monolithic semiconductor integrated circuit, a thin film transistor and a monolithic semiconductor integrated circuit (for example, DRAM) are formed in the almost same process. Therefore, a monolithic semiconductor integrated circuit can also be called thin film device. Thin film formation is usually a spatter and CVD. In the case of a silicon wafer substrate, it restricts, and the oxidizing [thermally] method and the epitaxial method join this. Thin film processing is the HOTORISO graphic method for having usually used the resist, and consists of the process which applies resist material on a thin film substrate, the process which exposes the range limited with the phot mask by ultraviolet radiation, the development process which removes the resist of the exposed section by the organic lye, the process which carries out etching removal of the thin film without resist covering, and the ablation process which removes a resist. The laser process which processes a direct thin film by the laser beam in addition to the resist method has attracted attention now.

[0003] In the manufacturing process of a thin film transistor, although it is an ideal that membrane formation and film processing are performed in a vacuum, the reduced pressure atmosphere of particular gas, or inert gas atmosphere, it is processed in many cases in the atmosphere which had temperature and humidity controlled in fact. When processing film processing by the wet system especially, it does not become the structure where the processor was sealed to the atmosphere, but will be processed in the atmosphere. Moreover, in delivery of the substrate between individual equipment, a substrate is once taken out in the atmosphere. For the substrate processed, this air extraction is detrimental. A substrate is influenced of the humidity in the atmosphere and causes a yield fall by variations, such as membranous oxidization and stress change. For example, the oxide film of aluminum and the oxide film of silicon become the cause that contact is poor. In order to remove this, it is necessary to add an oxide-film removal process, the number of processes increases, and this may cause a yield fall owing to. Moreover, great energy and great time are required for returning again the substrate once taken out in the atmosphere into a vacuum. That is, the energy and time of vacuum devices are hardly used for being spent in exhausting the atmosphere and maintaining a vacuum.

[0004]

[Problem(s) to be Solved by the Invention] this invention is accomplished in order to solve the above-mentioned problem, and it solves the fault by the oxidization by air atmosphere and adsorption which are produced at the time of transistor manufacture.

[0005]

[Means for Solving the Problem] After supplying a substrate to membrane formation / processing facility from the atmosphere, a substrate is not taken out in the atmosphere. That is, if it is in membrane formation equipment, after forming membranes in a vacuum working chamber and

returning to atmospheric pressure by inert gas, it sends to a processing facility, without replacing by the atmosphere. In a processing facility, the invasion of an unnecessary atmosphere is eliminated to atmospheric processing except for introduction of required processing gas and inert gas during the processing. A steam and carbon dioxide gas oxidize the activity side of silicon to the air profit at the time of processing, corrode the aluminum cross section which **********ed by chlorine-based gas in it, or reduce the alkalinity of a developer to it. these -- the instability of a process -- a measure thing -- it is -- H2 from atmosphere -- it is improved by removing O and CO2, and changes with perfectness by removing O2 These processing equipments are heating apparatus, such as a substrate washing station, a resist coater, an aligner, a developer, a wet etch station, a dry etching system, ablation equipment, laser-beam-machining equipment, laser-heating equipment, and infrared rays, and the atmosphere should just be in inert gas or a reduced pressure state. Moreover, it is better to perform a thing required in the middle of a process in inert gas atmosphere, even if it is in test equipment besides processing equipment.

[0006]

[Function] Since it does not take out in the atmosphere, it changes producible [the producible oxidization component in the atmosphere did not cause film oxidization, adsorption, film corrosion, and oxidization of an alkali component, and was stabilized].

[0007]

[Example] Probably, the purpose of further others of this invention and this invention and the feature of further others of this invention change that it is clear from explanation of the following which referred to the drawing.

[0008] Manufacture method>> of the transistor by <<this invention Drawing 1 (a) is one example of this invention, and is the conceptual diagram of the line which makes a thin film transistor (TFT). After washing by the washing station (1), a substrate is transported with the conveyance line (12) replaced by inert gas, has aluminum formed by the sputtering system (2), is transported with a conveyance line with a reduced pressure state (13), and is set to a CVD system (3). After a SiN film, an a-Si film, and an n type a-Si film are formed by the glow discharge method, again, the inside of inert gas is transported and a resist is applied by the coater (4). In an application, you may be inert gas atmosphere. Thus, it exfoliates in the state where air opening is not carried out, with exposure (5), development (6), etching (7), and resist ablation equipment (8). Subsequently, the side of aluminum wiring is inactivated with anodization equipment (9). Now, a gate line and an a-Si pattern are completed. Subsequently, although it is a drain wire, it sends to laser-beam-machining equipment (11), without breaking a vacuum after a spatter by the ITO sputtering system (10). A drain pattern is drawn by the laser beam of the suitable wavelength for removal of ITO, and TFT is completed.

[0009] Drawing 1 (b) is other examples of this invention. Here, it is elongating and membrane formation equipments, such as a sputtering system (14) and a CVD system (15), serve as conveyance between stations through the buffer room (21). A buffer room constitutes the substitution of reduced pressure atmosphere and inert gas atmosphere. A substrate injection & washing station (17) possesses the line which was separated from the atmosphere by the interior and which carries out substrate washing. A processing station (18) possesses the line separated from the atmosphere which processes resist processes, such as an application, exposure, etching, and ablation. An anodization station (19) and a laser-beam-machining station (20) possess the line of an anodic oxidation process and a laser-beam-machining process similarly. As for these interior of a station, the degree of greenhouse and dust concentration are controlled by the appropriate HVAC system. The interior of a station is usually uninhabited, and only when required, it is the structure where people put in an air shower from a **** entrance (22). Thus, the line of drawing 1 (b) has dust[non-]-izing or the economical structure which station-izes only a required part and carries out partial air-conditioning in the usual interior of a room for the whole line, without air-conditioning.

[0010] Next, an individual facility is explained. Drawing 2 (a) is a conceptual diagram of a wet facility which has two or more continuous processing rooms. A wet facility is a facility of a process which processes a substrate with medical fluids, such as for example, a washing process, a

resist application, wet etching, resist ablation, and an anodization process. A substrate (23) is the double structure of having the outside tub (26) which intercepts air atmosphere on the outside of the processing room (25) by which wet processing is carried out by the spray (24). The processing room (25) is replaced by N2 gas. It connects with the jet pipe and the outside tub (26) is in the reduced pressure state reduced from the pressure of atmospheric pressure and a processing room. N2 gas is supplied to a processing room, and since N2 gas which began to leak to the outside tub is exhausted, an air component does not go into a processing room. Moreover, the gas atmosphere of a detrimental processing room does not begin to leak into the atmosphere. Moreover, N2 gas supply to a processing room is performed through the dust filter, and changes with the structure of preventing poor generating by foreign matter adhesion.

[0011] Drawing 2 (b) is the cross section of one processing room of a wet facility. To the atmosphere, a processing room is an airtight structure mostly, and N2 is supplied and it consists of a tooth back with an inert atmosphere. Moreover, although it has conductance between the outside tubs (26) located in the upper part of other adjoining processing rooms and a processing room, since other adjoining processing rooms have the equal outline pressure, N2 gas flows to the outside tub (26) located in the upper part. When the conductance between a processing room (25) and an outside tub (26) is set to C1, as for C1, it is desirable to make it about at least 100 times of the conductance of leakage to the open air of a processing room (25). While a toxic substance prevents leaking out of equipment, it is for making N2 supply in a processing room into the minimum. Conductance C1 may be the configuration of drawing 3 . While conductance (33) can adjust with a variable wing, it consists of the processing room easily with the structure which can be removed so that the congelation of the adhering medical fluid can be removed. In addition, all the parts referring to a medical fluid are excellent in the structure which can carry out desorption easily, and the medical fluid tub (35) and the ** arrival version (36) which were shown in drawing 2 (b), and the medical fluid circulatory system (37) are individually put in block, and change with exchangeable structure. Like drawing 2 (b), it is required to form a pressure gage in a processing room and an outside tub, and to measure the pressure P1 of a processing room and the pressure P2 of an outside tub. The amount of supply Q of N2 gas (N2) is given by the following formula. <> Q (N2) =C1- (P1-P2) ---- As for the pressure P1 of (1) formula processing room, it is more desirable than atmospheric pressure or it that it is smallness a little. The pressure signal (30) of P1 is sent to the mass-flow controller (31) of N2 supply, and the amount of supply is controlled so that the value of P1 becomes an atmospheric pressure**2mmAq. grade. here -- P2 -- atmospheric pressure -- comparing -- at least -- 10mmAq(s). -- usually -- 50mmAq(s). -- smallness -- it is set as the value What is necessary is to send the signal of a pressure gage P2 to the damper of a jet pipe, and just to control the air capacity which adjusts and exhausts opening.

[0012] Next, leakage Q (atmosphere) from an atmosphere side to an outside tub is given by the following formula. <> Q(atmosphere) =C2- (P0-P2) ---- (2) formulas -- here, P0 is atmospheric pressure Although the conductance C2 of an outside tub has an as much as possible desirable smallness bird clapper, since observation of the processing interior of a room and the aperture for maintenance are prepared, considering the time of facility cost and maintenance, C2 is made into a perfect airtight and a bird clapper does not have C2 in zero. (2) Carry out division of the formula by (1) formula. Since P1 is atmospheric pressure mostly, the following formula is obtained. <> Q (atmosphere)/Q(N2) =C2/C1 --- From C1, if the (3) formula C2 is smallness, it will be made as for atmospheric leakage Q (atmosphere) to the N2 amount of supply Q (N2) and below equivalent. It is useless to exhaust Q (atmosphere).

[0013] Although a wet facility generally has the feature that cost is cheaper than a dry facility when what was described above is put in another way, this originates in a wet facility not being an airtight structure much. That is, it is size, so that the conductance C2 by the side of the atmosphere cannot be disregarded. Since the processing room and the outside tub are not distinguished in the conventional wet facility, when a processing room is exhausted in large quantities, the atmosphere trespasses upon the processing interior of a room in large quantities through conductance C2, and it is ****** about a bad influence to process atmosphere. On the other hand, when displacement was extracted and the N2 amount of supply was made [many], the pressure of a processing room

changed more than with atmospheric pressure, and there was a defect from which the detrimental controlled atmosphere containing the medical fluid of a processing room begins to leak out of equipment. The wet facility by this invention prepares an outside tub between a processing room and air atmosphere, and cancels the above-mentioned fault by exhausting an outside tub. Moreover, drawing 4 is the ** type view of the wet facility including the substrate injection from an atmosphere side. At the time of a substrate injection, the substrate soaping machine which touches the atmosphere is required. Here, two processing rooms and the loader room from an atmosphere side were shown. The N2 amount of supply is controlled so that it acts as the monitor of the pressure of a processing room and the interior of a processing room does not become large negative pressure. The outside tub which intercepts an individual processing room from air atmosphere has omitted the display. Each N2 amount of supply is controlled so that there is no pressure differential between processing rooms here. As for a loader room, opening with conductance C2 and a processing room has [opening by the side of the atmosphere] conductance C1. The pressure of a loader room is controlled by displacement so that 10mmAq(s). grade reduced pressure will be carried out from atmospheric pressure. The condition is the same as the content about which it argued by the (1) formula - (3) formula, and is good.

[0014] Next, drawing 5 is the conceptual diagram of one example of a dry facility. A dry facility points to the facility which performs for example, an exposure process, a CVD process, a spatter process, a laser annealing process, a laser-beam-machining process, a baking process, a dry etching process, etc. Here, the facility which performs a CVD process is explained to an example. A membrane formation room (38) possesses a process gas inlet (41) and an evacuation pump (43). In the conventional membrane formation facility, although after [a membrane formation end] air ejection is carried out, the unloader chamber for connecting the atmosphere and vacuum atmosphere is prepared, and air ejection is carried out, after introducing inert gas. That is, even if the chamber which introduces the inert gas following a membrane formation room included one room and the cooling room which cools a substrate, it was maximum that there are at most two rooms. It is the feature that the loader room (39) which has an exhaust air function following a membrane formation room (38), and two or more inerting rooms (40) continue in this invention. If it puts in another way, it can be said that it is the dry facility without the membrane formation room (38) processed under reduced pressure, the loader room having an inert gas introduction function and an exhaust air function, and air opening at the time of substrate processing by which inerting room continuous line arrangement is carried out. Substrate conveyance in inert gas is performed and a following membrane formation process or a following film processing process progresses because a substrate moves at an inerting room. Since it is necessary to carry out evacuation of the loader room (39), it has an exhaust air pump (43) and an inert gas inlet (42). An inerting room may be the combination of a jet pipe (44) and an inert gas inlet (42) instead of a vacuum pump. In addition, a conveyance-among inert gas line cannot be overemphasized by that you may be conveyance under reduced pressure.

[0015] Drawing 6 shows the case where put the substrate on the tray and substrate conveyance with a membrane formation line (45) is realized. A substrate is transported to the following process with a conveyance-among inert gas line (12) after a membrane formation end. On the other hand, it dissociates with the substrate after a membrane formation end, and a tray passes a membrane formation tray return line, returns to the head of a membrane formation line, and receives the following substrate. Membrane formation and the tray return line are also replaced by inert gas.

[0016] In addition, although only N2 gas was written as inert gas in this invention, it cannot be overemphasized that it is good with Ar gas, helium gas, the atmosphere that removed the steam, or a steam and the atmosphere which removed carbon dioxide gas.

[0017] Moreover, each of drawing 7 - drawing 12 is drawings showing one example of a wet facility. A wet facility of drawing 7 consists of a processing room lower unit (47), and a processing room up unit (48) and a medical fluid circulation unit (49), and is connected with joint (50) by packing (55), and it has mutually the feature which can carry out desorption exchange independently. It is the structure which a substrate conveyance system (51) is included in a

processing room up unit (48), and the medical fluid circulation motor (37) and the filter (52) are built into the spray system (24) and the medical fluid circulation unit (49) by the processing room lower unit (47), respectively, bundles up again at the time of exchange of each unit, and can be exchanged for a pure unit. The unit which exchange of a unit opens a lid (53) or (54), is made, and demounted it is fixed and cleaned by outside housekeeping. Moreover, (26) is an outside tub, and as mentioned above, it has an exhaust port (28). Next, the processing room (25) is carrying out the shape of a tube, and drawing 8 shows the cross section. (51) is a conveyance system and conveys a substrate (23) in the extended direction of a tube. A substrate is near [longest] the diameter of a tube cross section, space is extracted and the upper part and the lower part of a substrate do not have useless space. Although a medical fluid passes along a spray (24) and flows down to the upper shell of a substrate by the motor of the circulatory system (37), since there is no useless space, there is no stagnation in the flow. That is, there is the feature which the precipitation foreign matter which accompanies stagnation does not produce. (57) is the inspection hole prepared in the upside processing room. Moreover, drawing 9 adds an outside tub (26). In addition, the processing room (25) is carried out up and down for 2 minutes, and adjustment of it is possible. And it connects by packing (55). Moreover, drawing 10 is the external view of the wet facility with a tubed processing room. (58) is a tubed processing room and the substrate (23) sent in by the tubed conveyance section of (59) is processed. Moreover, drawing 11 supports a substrate (23) with a spin head (60), and it carries out wet processing, rotating. In order to rotate a substrate, when scattering of a medical fluid and the influence of stagnation are taken into consideration, it is desirable for a processing room (25) to be spherical, and it has a spherical processing room (61) like the appearance of drawing 12 .

[0018] The process flow of the TFT substrate (refer to drawing 14) made with the facility represented with such drawing 1 is shown in drawing 15 . After a substrate injection is carried out at a washing station (17), continuation membrane formation of aluminum film (62), a SiN/aSi film (63), (64), and (65) is carried out on a spatter conveyance way (14) and a CVD conveyance way (15) (refer to drawing 13). Since aluminum film and a CVD film are formed without being taken out in the atmosphere, it is not polluted, and it is preeminent for the adhesion force and the structure where the back taper by adhesion lack of ability etc. does not happen is acquired. As mask membrane formation is small carried out a little from aluminum film and a CVD film is shown in drawing 13 , overflowing aluminum film is used as an electrode terminal at a next anodization process. Subsequently, it is processed into the configuration of a gate line at a processing station (18). And it is conveyed without corroding aluminum film with the moisture in the residual chlorine in an etchant component, and the atmosphere, since a conveyance-among inert gas line (16) is conveyed, and moves to an anodization station (19). Here, the side attachment wall of a gate line is inactivated and it is insulation-ized electrically. And although sputtering of ITO is carried out by the sputtering system (14), since the front face of an n type aSi film is not taken out in the atmosphere, it is stable and contact of ITO and n type aSi becomes what was always stabilized. It is conveyed at a laser-beam-machining station (20), carrying out an ITO spatter, ITO is processed into the configuration of a drain wire here, and the n type a-Si film of the channel section is removed by laser. A TFT substrate is completed now. Drawing 16 illustrated only 1 pixel with the plan of a TFT substrate. The A-A' cross section of drawing 16 is shown in drawing 17 . It turns out that the cross section of Gate aluminum (62) is protected by the alumina Chemicals film (75), and is insulated with the ITO drain (66). Subsequently, as shown in drawing 14 , after being combined with a finish plate substrate (67), by using a finish plate substrate as a mask, etching removal is carried out, and aluminum is exposed, and the SiN film and aSi film on a gate terminal are a terminal, and are carried out. The liquid crystal device shown now in drawing 14 is completed.

[0019] In addition, although this patent explained using the TFT process, the same thing can be said also with the production line of a monolithic semiconductor integrated circuit.

[0020]

[Effect of the Invention] There is no influence of a natural oxidation film and water adsorption, it is stable and a process without the loss of purge timing is offered.

[Translation done.]

CLAIMS

[Claim(s)]

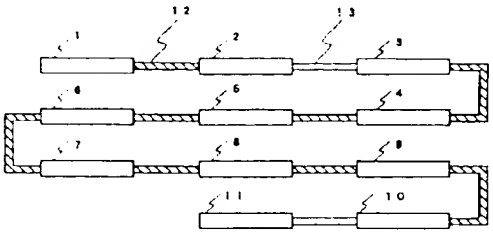
[Claim 1] The manufacturing method of the thin film device characterized by not exposing the above-mentioned substrate to the atmosphere in all processes or some continuous processes in the manufacture method of the thin film device obtained by repeating thin film formation and its processing on a substrate from a substrate injection before completion.

[Translation done.]

DRAWINGS

[Drawing 1]

図1
(a)



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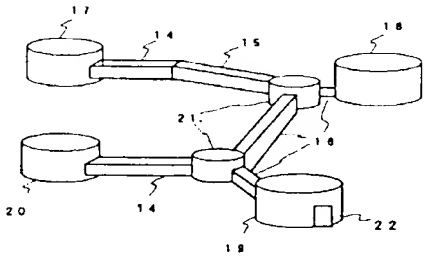
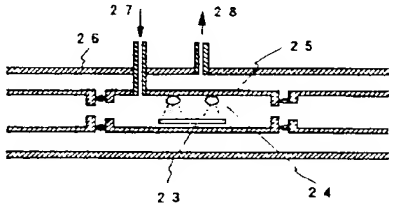


[Drawing 2]

図2
(a)



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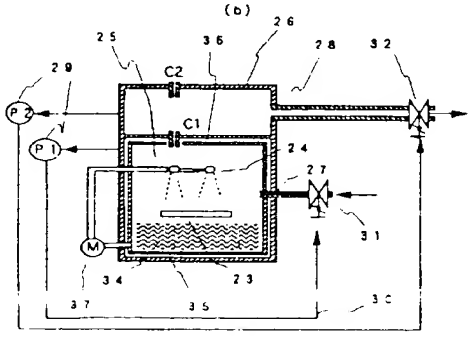
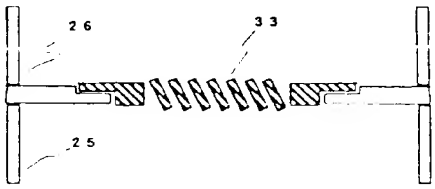


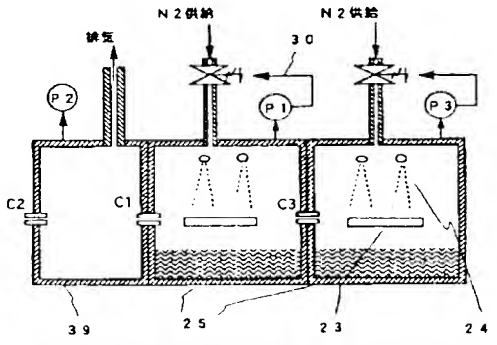
[Drawing 3]

図3



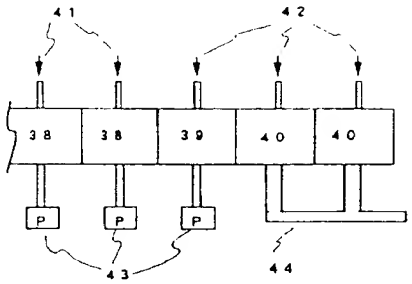
[Drawing 4]

図4



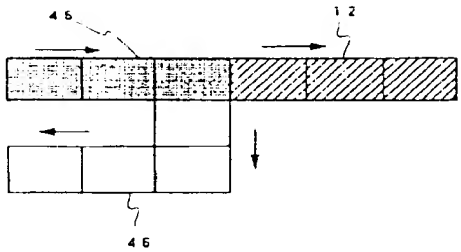
[Drawing 5]

図5



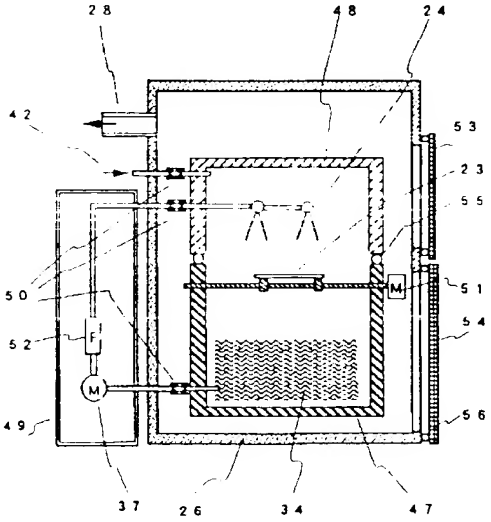
[Drawing 6]

図6



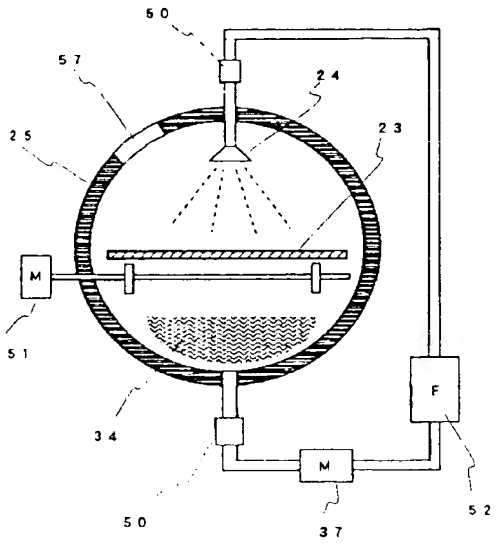
[Drawing 7]

図7



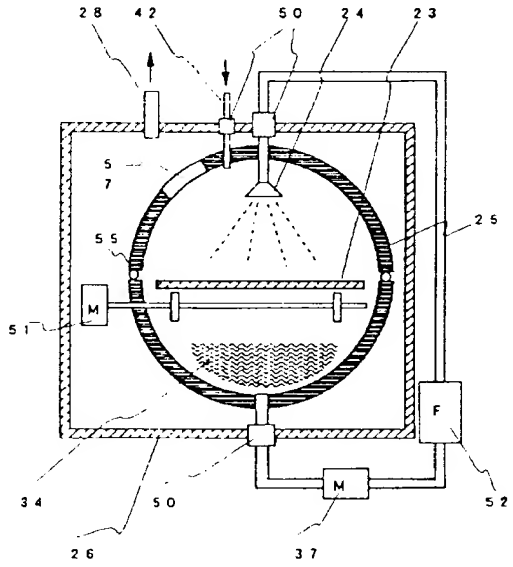
[Drawing 8]

図8



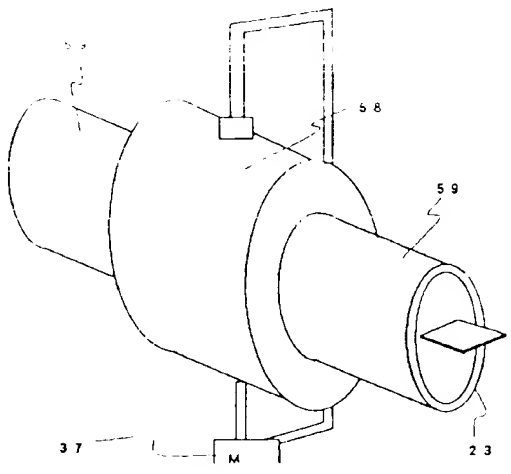
[Drawing 9]

図9



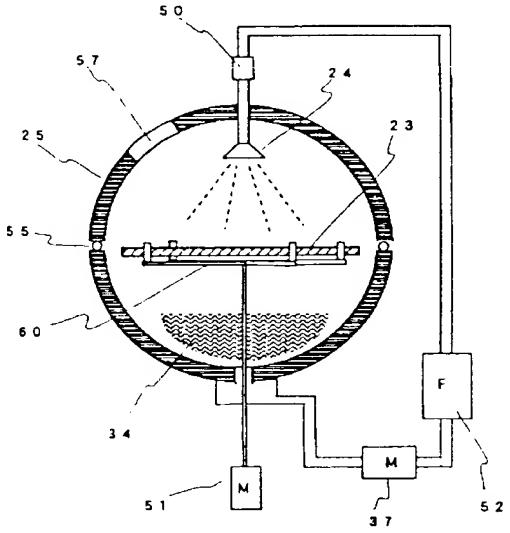
[Drawing 10]

図10



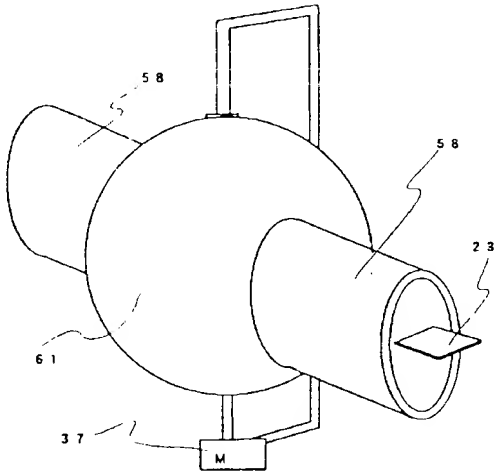
[Drawing 11]

図11



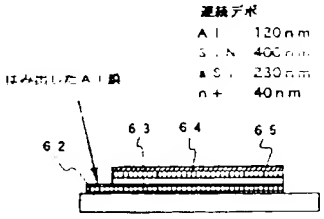
[Drawing 12]

図12



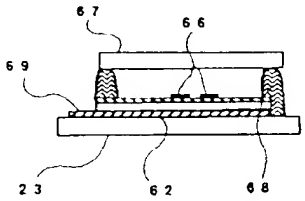
[Drawing 13]

図13



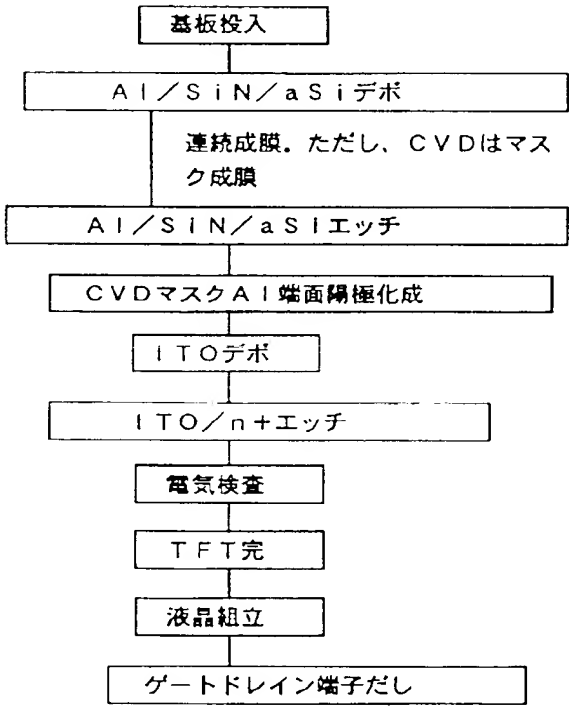
[Drawing 14]

図１４



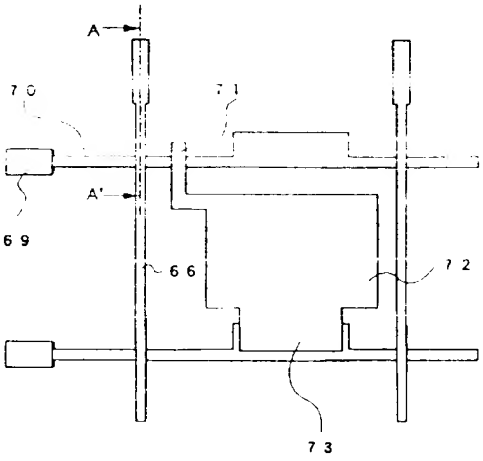
[Drawing 15]

図１５



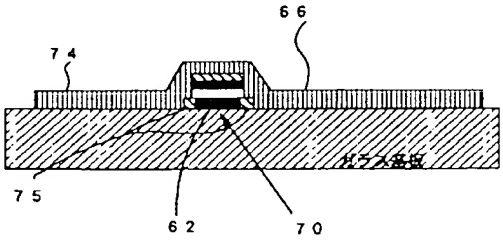
[Drawing 16]

図１６



[Drawing 17]

図17



[Translation done.]